Social Exclusion modulates pre-reflective Interpersonal Body Representation

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Acknowledgments

MC and AM were supported by a grant from the Volkswagen Foundation "European Platform for Life Sciences, Mind Sciences and the Humanities" (Ref: 85 639).

Abstract

Perception of affordance is enhanced not only when that object is located in one's own peripersonal space, as compared to when it is located within extrapersonal space, but also when the object is located in another person's peripersonal space (as measured by a Spatial Alignment Effect (SAE)). It has been suggested that this reflects the existence of an Interpersonal Body Representation (IBR) that allows us to represent the perceptual states and action possibilities of others. Here, we address the question of whether IBR can be modulated by higher-level/reflective social cognition, such as judgments about one's own social status. Participants responded with either the right or the left hand as soon as a go signal appeared. The go signal screen contained a task-irrelevant stimulus consisting of a 3D scene in which a mug with a left-facing or right-facing handle was positioned on a table. The mug was positioned either inside or outside the reaching space of the participants. In a third of the trials, the mug was positioned within the reaching space of an avatar seated at the table. Prior to this task we induced an experience of social ostracism in half of the participants by means of a standardized social exclusion condition. The results were that the SAE that normally occurs when the mug is in the avatar's reaching space is extinguished by the induced social exclusion. This indicates that judgments about one's own social status modulate the effect of IBR.

Keywords: Interpersonal Body Representation; Affordance; Social Exclusion; Spatial Compatibility Effect.

Introduction

The term 'interpersonal body representation' (IBR), (Thomas et al. 2006) refers to a putative visual–tactile association mechanism for representing our own bodies that might also be used for representing the bodies of other people. Thomas and colleagues (2006) used a cueing paradigm to investigate the role of this spatial mapping in the processing of sensory events on one's own or another's body. Cues consisted in brief flashes of light at one of several locations on the other's body, while the target was a tactile stimulus delivered either at the same (congruent) or at a different (incongruent) anatomical location on the participant's body as the visual cue. There was a significant congruency effect for anatomical body position, as participants were faster at detecting tactile stimuli on their own body when a visual stimulus was delivered at the same location on the other's body. Crucially, this effect was body-specific, not occurring when visual cues were delivered at a non-bodily object (e.g. a house). Thomas and colleagues suggested that this body-specific congruency effect is an outcome of the workings of an IBR. The IBR was proposed to be an automatic sensory mechanism for visual–tactile association that underlies "understanding of others' perceptual states" and "may reflect a first step towards the human ability to track the specific, detailed contents of other minds" (Thomas et al., 2006, p. 328).

Recently we suggested with behavioral and neurophysiological studies that such an IBR exists not only in the visuo-tactile, but also in the motor domain (Cardellicchio et al. 2012; Marcello Costantini et al. 2011c). In those studies we investigated whether and to what extent the perception of affording features of objects, which have been shown to be modulated by the spatial relation between the perceiver and object (Marcello Costantini et al. 2011a; Marcello Costantini et al. 2011b; M Costantini et al. 2010; M. Costantini and Sinigaglia 2012; Ferri et al. 2011), may be influenced by the presence of another individual. In particular, in the behavioral study (Marcello Costantini et al. 2011c), we took advantage of the spatial alignment effect (SAE) paradigm.

Participants were asked to imitate a seen grasping motor act with their right or left hand when presentated with a task-irrelevant go signal. The go signal was a 3D scene with a mug placed on a table with its handle oriented toward the right or the left, that is, the go signal was spatially congruent or incongruent with the grasping movement that the participant was about to imitate. The mug could be located either within the peripersonal (30 cm) or extrapersonal (150 cm) space of the participants. Notably, an avatar was seated on a chair at the table in some trials, while in others a virtual non-corporeal object (a cylinder) with the same volume as the avatar was “seated” on the chair. We found that the SAE occurred not only when the affording object was presented within the reaching space of the participant but also when it was presented within the peripersonal space of the avatar. In other world, results showed that the presence of a potential co-actor triggers a mapping of another’s peripersonal space onto the participants’ peripersonal space, representing the out-of-reach object as ready-to-hand for the other individual. We speculated that the matching between the representation of the space surrounding the body of another with the representation of the action space of our own bodies provides us with an immediate pre-comprehension of the other’s body as an acting body as well as allowing us to comprehend the effective range of the other’s bodily agency.

Thus, both Thomas et al.’s (2006) and Costantini et al.’s (Cardellicchio et al. 2012; Marcello Costantini et al. 2011c) data points in the same direction, suggesting the existence of pre-reflective mechanisms (IBR) allowing us to represent others’ perceptual states and motor possibilities. Such pre-reflective mechanisms have been proposed as forming the basis of human social cognition. But how deeply is our ability to represent others' perceptual states and motor possibilities implicated in social cognition? Is such an ability sensitive to the social dimension in which it is instantiated (Bernhard Hommel et al. 2009; Iani et al. 2011)? Indeed, the ways in which social context interacts with these mechanisms is poorly understood and it is not known whether IBR is influenced by higher-level/reflective social cognition. If it is, then it should be sensitive to the manipulation of social variables and depend on an agent's judgments of the social aspects of a given situation. One possible such social variable is the experience of social exclusion, which arguably is the outcome of a reflective judgment. This is shown by the fact that such experience is sensitive to whether you have been excluded, for instance, by members of your own group or by out-group members (Gonsalkorale and Williams 2007).

Here, we provide some empirical data that can help shed new light on the range of these mechanisms. In particular we investigated the impact of an induced experience of social exclusion on the understanding of others' motor possibilities by taking advantage of the SAE paradigm. As in the previous behavioral study (Marcello Costantini et al. 2011c), participants were asked to provide a response, with either their right or their left hand, on presentation of a task-irrelevant go signal represented by a 3D scene with a mug placed on a table, its handle oriented towards the right or the left (i.e., congruent or not with the responding hand). The mug could be located either within or outside the reaching space of the participants, but in a third of the trials, it was close to another virtual individual that was seated on a chair at the table. In half of the participants, we induced an experience of social ostracism by means of a standardized social exclusion condition, that is, using the Cyberball game (Williams et al. 2000). In this paradigm, the participant and two other supposed players (which in fact are computer generated) played a virtual ball-tossing game, during which the degree of social inclusion is controlled by the manipulation of the number of throws received from the computer-generated players. Included participants receive the ball regularly throughout the game while ostracized participants receive only the first two throws. Previous research on this paradigm indicates that ostracized participants not only perceive themselves as being excluded but also have lower satisfaction of fundamental needs than non-ostracized participants (Williams et al. 2000; Zadro et al. 2004). For example, one such fundamental need is belongingness, defined as the human need to be an accepted member of a group. We hypothesized that social exclusion does have an effect on understanding of others' motor possibilities, and hence, that only participants who had been excluded would show a lack of SAE when the mug is outside their reaching space but close to the virtual avatar.

Methods

Participants

Forty female participants (mean age (SD): 23.25 (3.33) years) took part in the study. They were randomly assigned to either the Inclusion or the Ostracism group according to the experimental manipulation of their inclusionary status (20 participants for each group). We choose to include only female participants because it has been suggested that they are more sensitive to the ostracism effects induced by the Cyberball game (Sebastian et al. 2010; Weik et al. 2010).

All participants were right-handed, had normal or corrected-to-normal visual acuity, were naive as to the purposes of the experiment, and gave their written informed consent. The study was approved by the Ethics Committee of the ''G. d'Annunzio'' University, Chieti, and was conducted in accordance with the ethical standards of the 1964 Declaration of Helsinki.

Stimuli

In the experimental task, two sets of colour images (1024 × 768 pixels) were used. The first one included coloured pictures depicting either a right or a left hand pantomiming a precision grip movement (instruction stimuli), while the second one included 3D scenes (go stimuli). These scenes were created by means of 3DStudioMax™ and depicted 3D virtual rooms in which there was a table with a mug on it (geometric field of view value: ≈75 horizontal degrees; Fig. 1). The mug was placed either within the peripersonal (50 cm) or in the extrapersonal (150 cm) space of the participants, and its handle was oriented either to the right or to the left. In one third of the trials, an avatar was seated on a chair on the long side of the table, facing the object, while in another third of the trials a non-corporeal object, namely a cylinder, was placed on the same chair. When either the avatar or the cylinder was present it was seated on the same side of the table as that toward which the handle was directed, thus being placed either on the right or on the left side of the table. It is important to note here that when the avatar was present, the mug was placed within his peripersonal space (i.e., the mug was perceived as reachable by the avatar, as confirmed by a pilot study). Stimuli were presented by means of a LCD monitor (1024×768 pixels). All stimuli were displayed on a black background, from a viewing distance of 57 cm.

Figure 1 near here

Procedure

Social inclusion manipulation – After obtaining informed consent, participants were told that the study involved the effects of mental visualization on their pantomime ability, and that to assist them in practicing their skills at mental visualization they would be playing an Internet game with other confederates. Participants were thus asked to play the Cyberball game (Williams et al. 2000; Williams and Jarvis 2006), a virtual ball tossing game that induces social exclusion in a highly standardized manner. In this paradigm, participants were led to believe that they were playing over the internet with two other people who are taking part in similar experiments but who are, in fact, computer generated (see (Williams and Jarvis 2006) for a complete description).

We manipulated the degree of social inclusion (ostracized or included) via the number of times participants received the ball from other players. Participants in the inclusion condition received the ball for roughly one-third of the total throws, while those in the exclusion condition received the ball only twice at the beginning of the game. The game was set for 40 total throws, corresponding to approximately 6 min. At the end of the game, the website instructed participants to inform the experimenter that they had finished, and they were then asked to perform the spatial alignment effect task (see below). Note that the other players in the Cyberball game were not presented to the participants in a way that resembled the avatar used in the go stimulus for the SAE task.

Spatial alignment effect task – Each trial began with the presentation of a white fixation cross at the centre of the screen followed by presentation of the instruction stimulus for 150 ms. After a variable delay (150-450 ms), the go stimulus was presented for 500 ms. Participants were requested to operate on a button box with the hand presented in the instruction stimulus as soon as the go stimulus appeared. Thus, congruent trials refer to the condition in which participants had to respond with either the right or the left hand when the handle of the mug (presented in the go stimulus) was located ipsilaterally; on the contrary, incongruent trials refer to the condition in which the responding hand and the handle were in opposite hemispaces. At the beginning of each trial, participants rested their right and left index fingers on two response buttons arranged horizontally on a button box. Responses were given by lifting the index finger of the responding hand. Reaction times were recorded and analyzed off-line.

Each participant performed the SAE task right after the social manipulation (see above). The task was composed of 192 trials. The presentation of the stimuli and the recording of participants' responses were controlled by a custom software (developed by Gaspare Galati at the Department of Psychology, Sapienza Università di Roma, Italy; (Gaspare Galati et al. 2011; G. Galati et al. 2008), implemented in MATLAB (The MathWorks Inc., Natick, MA, USA) using Cogent 2000 (developed at FIL and ICN, UCL, London, UK) and Cogent Graphics (developed by John Romaya at the LON, Wellcome Department of Imaging Neuroscience, UCL, London, UK).

Basic Needs Questionnaire – After completing the SAE task (see above), participants were asked to complete a questionnaire (Zadro et al. 2004). To assess the effectiveness of the social inclusion manipulation, participants estimated the percentage of throws they received and rated on nine-point scales how much they were included and accepted during the game. The questionnaire also contained twelve questions that prompted the participants to assess their felt level of satisfaction for four basic needs during the game: belonging, control, self-esteem, and meaningful existence (the satisfaction of each need was assessed by three items). Mood was also assessed using four nine-point bipolar questions: bad/good, happy/sad, tense/relaxed, and aroused/not aroused (see Table 1).

Results

Basic Needs Questionnaire – To assess the effectiveness of our Cyberball manipulation, we compared the average score of participants in the inclusion and ostracism conditions by means of two-sample two-tailed t-tests. There were three manipulation checks assessing inclusionary status. As expected, participants in the ostracism condition reported that they felt significantly less included and accepted than participants in the inclusion condition, and also reported to have received a lower percentage of throws (all ts(38) > |4.92|, all ps < .001) (see Table 1). We next computed the average for the items assessing each need and the mood, as a reasonable level of internal consistency was found (all Cronbach's alpha coefficients > .62). Ostracized participants reported lower basic needs satisfaction, as well as less positive affect, than did included participants (all ts(38) > |3.21|, all ps < .003). These results confirm that our manipulation of social inclusion was effective.

Table 1 near here

Spatial alignment effect – Trials in which participants failed to respond correctly (3.27%) or with a response time lower than 100 ms (3.28%) were discarded from the analysis on RTs. We then calculated the mean RTs for each condition, and responses longer than two standard deviations from the individual mean were treated as outliers and were not considered (4.36% of the dataset). Data were entered in a 2×2×3×2 mixed-model ANOVA with inclusionary Status (inclusion vs. ostracism) as the between-subjects factor, and Location of the object (relative to the participant: peripersonal vs. extrapersonal space), Presence of another individual (absent vs. cylinder vs. avatar) and Congruency (between the responding hand and the handle of the mug: congruent vs. incongruent) as within-subjects factors. Paired-sample two-tailed t-tests were performed where necessary.

RT analysis revealed a significant Congruency main effect (F(1,38) = 8.28, p = .007, ηp2 = .18), with RTs in congruent trials (360.8 ms) that were faster than those in incongruent trials (370.9 ms). Moreover, the Congruency effect was modulated by the Location of the object (F(1,38) = 10.57; p = .002; ηp2 = .22). Simple effect analysis revealed a reliable SAE in the peripersonal condition (i.e., higher RTs in incongruent compared to congruent trials: 372.8 and 356 ms, respectively; t(39) =

|5.2|, $p < 0.001$), but not on extrapersonal trials (incongruent and congruent trials: 369 and 365.5 ms, respectively; $t(39) = |0.85|$, $p = 0.4$); in addition, RTs in congruent trials were faster in peripersonal than in extrapersonal space ($t(39) = |2.54|$; $p = 0.015$). Finally, the higher order 4-way interaction resulted significant ($F(2,76) = 3.77$, $p = .027$, $\eta p2 = .09$) (see Fig. 2). In order to better understand this latter result, we performed two separate 2×3×2 mixed-model ANOVAs on peripersonal and extrapersonal trials, with inclusionary Status as the between-subjects factor, and Presence of another individual and Congruency as within-subjects factors.

The ANOVA on peripersonal trials confirmed the significant Congruency main effect ($F(1,38) = 24.87$, $p < .001$, $\eta p2 = .40$), with faster RTs in congruent compared with incongruent trials. No further significant effects were found (all $Fs < 1.14$, all $ps > .33$, all $\eta p2s < .03$). On the contrary, the ANOVA on extrapersonal trials revealed a significant inclusionary status by Presence by Congruence interaction ($F(2,76) = 3.48$, $p = .036$, $\eta p2 = .08$). Simple effect analysis revealed a reliable SAE only for the inclusion group when the avatar was present (incongruent and congruent trials: 363.1 and 343.9 ms, respectively; $t(39) = |2.38|$, $p = 0.028$), indicating that participants who experienced a social inclusion event mapped the peripersonal space of the avatar. Crucially, the SAE on avatar trials was annulled in the ostracized group (incongruent and congruent trials: 378.3 and 389.8 ms, respectively; $t(39) = |1.94|$, $p = 0.067$). Please note that in this condition participants tend to be faster in incongruent as compared to congruent trials (Fig. 2).

Figure 2 near here

Regression analysis – Finally, we performed a correlation analysis to better verify if the experienced ostracism, as assessed by our participants' needs satisfaction and mood, was effective in modulating the mapping of the avatar's peripersonal space. With this aim, we first computed the (remapped) spatial alignment effect in the extrapersonal space in the presence of the avatar (RSAE). The RSAE value was calculated for each participant as the difference between invalid and valid trials in this condition. Next, we performed a series of regression analyses between the RSAE of our participants and their basic needs and mood scores. The analysis revealed that all the questionnaire scores significantly predicted the RSAE (all βs > .34, all $ts(38) > 2.21$, all $ps < .03$) and, in particular, the questionnaire score that best predicted the RSAE was the need to belong ($\beta > .45$, $t(38) > 3.11$, $p < .004$; Fig. 3). Note that these results remained the same after eliminating two outliers (standardized residual > |2|). To sum up, regression analyses indicate that participants' mapping of the peripersonal space of another potential actor was modulated by threat to their need for belongingness.

Figure 3 near here

Discussion

There is evidence that the other's bodily space might be mapped onto one's own body representation. Earlier behavioral and neurophysiological studies (Cardellicchio et al. 2012; Marcello Costantini et al. 2011c; M. Costantini and Sinigaglia 2012; Thomas et al. 2006) have shown that a visuo-tactile as well as a motor mapping can be found in humans at the level of bodily (or personal) and peripersonal space. These mapping mechanisms have collectively been called IBR – Interpersonal body representations - and been taken to be pre-reflective mechanisms that allow us to "track the specific, detailed contents of other minds" (Thomas et al. 2006).

From a theoretical point of view, something like the IBR is to be expected by the common coding theory (B. Hommel et al. 2001). This theory claims that perceptual representations (e.g. of things we can see) and motor representations (e.g. of hand actions) are linked, since the same representation (a common code) is shared by both perception and action. This is the case not only within one individual but also across individuals: the same representation is used in the perception of another's unfolding action and in the planning of one's own unfolding action. This mapping ought to hold also between the perception of another's action possibilities and the appreciation of our own action possibilities. Hence, the "common code" could play an important role in enabling us to predict what others are likely to do given the situation they are in. However, note that while IBR is supposed to be a particular kind of representation that relates the bodily and peripersonal spaces of self and other, according to the common code explanation there is simply no distinction between self-performed actions and other perceived events at the level of the common code (B. Hommel et al. 2001). In other words, the common code approach assumes that features of events that actually relate to others are not treated differently from features of events related to oneself. This feature of action planning and action perception could then be exploited in order to understand others without reliance on a specific mapping mechanism. Perhaps appeal to an IBR is compatible with this common code explanation—the IBR could be the outcome of a more basic common code—but we will here frame the discussion of the results in terms of IBR.

Given that there is an IBR in the visuo-tactile domain, it is plausible that there is also an IBR in the motor domain, as suggested by Costantini and colleagues (Cardellicchio et al. 2012; Marcello Costantini et al. 2011c; M. Costantini and Sinigaglia 2012). After all, we have many representations of our own body in different formats, ranging from amodal abstract descriptions to visuo-tactile maps and motor maps. (If the common coding theory holds, then we should also expect that all these representations are shared, irrespective of format.)

While IBR may underpin a basic form of apprehension of others' action possibilities and perceptual states, it is clearly not the only important mechanism that underpins social cognition. High-level reflective processes such as in-group/out-group discriminations and inferential mental state attributions are also important. There are interesting questions concerning the interactions between these levels. Clearly, it is possible that pre-reflective mechanisms enable higher-level reflective processes. But it is also interesting to consider whether and how higher-level reflective processes may modulate pre-reflective mechanisms. That psychological effects can be modulated by one's experienced social status has been found in other studies (Bernhard Hommel et al. 2009; Kuhbandner et al. 2010). One such effect is the Social Simon effect. The standard version of this effect (Simon and Rudell 1967) is observed when people give a spatially defined response, such as pressing one of two (left/right) buttons located side-by-side, to a non-spatial feature (such as the colour) of a stimulus that includes some spatial information (such as location or direction) that is either congruent or incongruent with the response. Reaction times are slower when there is no correspondence between the spatial information in the stimulus and the responding hand. The effect has been shown to occur not only when acting and perceiving in isolation, but also when acting and perceiving in a social context (Sebanz et al. 2006a; Sebanz et al. 2003; Sebanz et al. 2006b; Sebanz et al. 2007). Strikingly, Hommel and colleagues (2009) demonstrated that the social version of the Simon effect is modulated by a social manipulation. They instructed participants to perform a Social Simon task with either a cooperative or a competitive co-actor. They found that the Social Simon effect occurs only if actor and co-actor are involved in a positive relationship, but not if they were involved in a negative relationship.

In order to determine how IBR is related to higher-level processes, we have investigated whether it is sensitive to one of many possible social factors, namely social exclusion. We could have used other social manipulations, such as cooperative versus competitive context (see e.g., (Bernhard Hommel et al. 2009), but we chose social exclusion because it effects how we relate to others in general rather than to a specific cooperative/competitive partner.

Our results suggest that this mechanism can be modulated by a social manipulation such as social exclusion. With our current data we are not able to say whether this influence is direct or indirect since the behavioral outcome would be the same. However, what we can say is that IBR is associated with the social world. The question is: how do reflective judgments about the social world influence the pre-reflective IBR?

One possibility is that this top-down modulation is actually influencing where the participant focuses his or her attention. It has been shown that attention is a necessary condition for low-level sensory-motor mechanisms to be activated. For instance, in the domain of affordance perception, Tipper et al. (S. Tipper et al. 2006; S. P. Tipper 2010) instructed participants to report the colour of door-handles presented on a computer screen, thus focusing their attention on a non-action relevant object feature. They found that no SAE occurred in this condition. In our case, it might be that social exclusion makes it less likely that the participant's attention will be captured by what the other is attending to, since social exclusion makes one attend less to others in general. When the SAE occurs, it is because the attention of the other drives the allocation of our own attentional resources toward the object. In the social exclusion condition then, the absence of SAE when the object is in the other's reaching space, would be due to the fact that the participant's attention is not being captured by the other's attention in the normal way.

This interpretation of our results is in line with the findings of Van Baaren and colleagues (2003). They investigated whether or not priming participants with either interdependent or independent self-construal words would influence nonconscious mimicry (Chartrand & Bargh, 1999). According to social psychologists, independent self-construal accentuates self-related features and minimizes the influence of others in the self-schema, resulting in a bounded and autonomous self that is distinctly separate from others. Conversely, the interdependent self-construal represents inclusion of others in the self, particularly with regard to others who are part of important relationships, as well as in-group members from small, well-connected groups (Aron, Aron, & Smollan, 1992; Brewer & Gardner, 1996; Markus & Kitayama, 1991; Yuki). They found that experimental induction of independent self-construals produced less nonconscious mimicry than interdependent self-construals. According to the authors, different self-construals involve differences in information processing. A context-independent processing style tends to lead to perceptual differentiation and a tendency to ignore contextual and background factors (Nisbett et al., 2001), which would likely lead to increased attention to the self and decreased attention to others; thus, fewer mannerisms of others would be observed, decreasing the likelihood of mimicry. In contrast, a processing style that is context-dependent and involves assimilation would subsequently lead to behavioral assimilation, because more attention is paid to the contextual environment and changes within it, making mannerisms more noticeable or more likely to be mimicked.

As a possible objection to this hypothesis, one might argue that the lack of SAE is rather due to a general decrease of cognitive resources induced by social exclusion. Indeed, social exclusion appears to disrupt cognitive functioning in general, leading to decreased attentional capacities and processing speed (Baumeister et al. 2002). This would explain the lack of SAE in the social exclusion/extrapersonal condition, but we should then also expect there to be a lack of SAE when the participant has been socially excluded and the object is in her own reaching space. However, the social exclusion manipulation selectively eliminates the SAE in the extrapersonal space condition only. Our results are therefore consistent with the hypothesis that social exclusion selectively redirects attentional resources away from the other, but not with the competing hypothesis that any reduction in attentional resources will eliminate SAE. We suggest that the redirection of attention away from the other has the effect that IBR is not instantiated. According to this suggestion the instantiation or non-instantiation of IBR is not directly influenced by reflective social judgments, yet it is indirectly influenced through changes in attentional focus that those social judgments produce. Crucially, we claim that if differences in attentional focus between conditions have a part to play in the explanation of whether IBR is instantiated, then those differences in attentional focus are themselves to be explained by judgments about social inclusion and exclusion.

Research on the possible link between high-level social cognition and pre-reflective mechanisms is still in its infancy. Future studies should look at the impact of other social manipulations on IBR. In our study we induced a feeling of exclusion, but other social manipulations could be carried out. For example, it would be interesting to compare the effect of competitive versus cooperative engagement on IBR, and the extent to which cultural identity and ethnicity impact IBR (Colzato et al. 2010).

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Figure 1. Go stimuli used in the Spatial alignment effect task.

Figure 2. Mean response times (RTs) in the experimental conditions. Error bars represent within-subjects standard errors (Morey 2008). *p<.05

Figure 3. Regression plot showing the significant correlation between the global questionnaire score for the belonging basic-need and the remapped spatial alignment effect (RSAE, see text for details).

Table 1: Mean (SD) of the questionnaire scores for both included and ostracized participants (1= not at all to 9 = very much so for all scales, unless otherwise stated). The statistics for the Included vs. Ostracized comparisons (two-tailed two-samples t-tests) are also showed in the rightmost columns.